NATIONAL AIRSPACE SYSTEM MODERNIZATION

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NAS Modernization is the FAA's long-term plan to meet the growing demand for air traffic services. The concept of Free Flight is the impetus for many of the changes of NAS Modernization. Free Flight will give pilots greater flexibility in determining their routes and speeds. NAS users will face fewer restrictions in their flight operations resulting in lower operating costs and fewer delays.

The myriad projects of NAS Modernization, and their interrelationships, are described in detail in the NAS Architecture. The NAS Architecture was released as a living database in April 2000 and reflects the latest results of ongoing research, development of technologies, and changes in funding. The Architecture database provides a service-based view of the NAS.[7] This chapter summarizes the programs that support NAS services and describes the initiatives that are already underway.

Because the FAA's air traffic control system operates continuously, most changes, from the installation of new equipment to the implementation of new procedures, will take place while aircraft are using the system. Maintaining the system's level of safety under these conditions requires careful planning and execution. Therefore, NAS Modernization has been designed as an evolutionary process that will sustain current NAS operations while new technologies are introduced, proven, and then deployed. This process will allow for a smooth transition from one technology to another, sufficient time for users to equip, and realistic schedules for service providers to test, train for, and deliver services. NAS Modernization is divided into three phases, from 1998 to 2015:

Phase 1 (1998-2002)
Focuses on sustaining air traffic control services and delivering early benefits; satellite-based navigation systems will be deployed and air-to-air surveillance will be introduced.

Phase 2 (2003-2007)
Concentrates on deploying the next generation of communications, navigation, and surveillance (CNS) equipment and the automation upgrades necessary to accommodate new CNS capabilities.

Phase 3 (2008-2015)
Completes the required infrastructure and integration of automation advancements with new CNS technologies that will enable Free Flight capabilities throughout the NAS.

9.1 Milestones in NAS Modernization

NAS Modernization is a complex undertaking that cannot be adequately described in this plan. Readers interested in the details of modernization should consult the full NAS Architecture. This chapter highlights milestones that have been recently achieved and important projects that are already underway.

Milestones include the full deployment of the Display System Replacement System, the replacement of the HOST computer with new computers, and the completion of the

7 The complete NAS Architecture 4.0 and a summary called the Blueprint for NAS Modernization are posted on the FAA web site at www.faa.gov/nasarchitecture. The architecture database can be accessed through the Capability Architecture Tool Suite.

Common ARTS radar program. Ongoing projects include the new technologies of Free Flight Phase 1, their expansion under Free Flight Phase 2, and Safe Flight 21.

9.1.1 Full deployment of The Display System Replacement

The FAA dedicated the final Display System Replacement (DSR) on July 14, 2000, at the Leesburg ARTCC. The first major component of the FAA's modernization of the nation's en route air traffic control system infrastructure, the DSR program was completed on time and within budget, and the new equipment is now operational at all 20 ARTCCs.

DSR updates the en route air traffic control systems computer and display equipment. It replaces 20- to 30-year old equipment that was declining in reliability and increasingly expensive to maintain. Monochrome circular radar screens have been replaced with 20 x 20-inch, high-resolution color monitors to display radar tracks and other air traffic information, while the computers have greatly increased data processing capability. DSR provides high reliability and availability through hardware redundancy, fault-tolerant software design, and primary and backup networks.

DSR has an open architecture that can accommodate software upgrades and new technologies. This means that DSR will be a cost-effective platform for future upgrades to air traffic control capabilities. Early improvements will include the Voice Switching Control System digital communication system and the User Request Evaluation Tool and other Free Flight Phase 1 technologies.

The success of DSR validates the FAA's revised approach to modernization: acquiring new systems by using an incremental approach rather than tackling large, complex projects all at once. With DSR, the FAA concentrated on replacing the controllers' workstations and other supporting equipment and plans to add new functions and capabilities later. In implementing DSR, the FAA also worked actively with internal users (controllers and maintenance technicians) and with external users (the airline industry) to make decisions more collaboratively.

9.1.2 HOST and Oceanic Computer Replacement

The HOST and Oceanic Computer System Replacement (HOCSR) program has replaced existing computers at the 20 ARTCCs. The new equipment replaced rooms full of older, far less capable hardware that had been deployed in 1986 through 1988 as an interim upgrade (the new computers reduce required facility space from 900 to 74 square feet). Many of the hardware components had reached the end of their commercial lives. The new HOCSR computers should be in use until at least 2008. The new system has extremely high reliability, significantly improved maintainability, and more complete backup than the equipment it replaces.

The en route center automation system is the foundation of the FAA's automated air traffic control environment. It receives, processes, coordinates, distributes, and tracks information on aircraft movement throughout the nation's airspace. The HOCSR computers process incoming data and provide it to the new DSR multicolor displays. The computers also connect to other FAA services, including air traffic control towers, flight service stations, adjacent flight information regions, other centers, and to external organizations such as the U.S. Customs Service and the military.

The first HOCSR reached its initial operational capability at the New York ARTCC early on January 24, 1999, declared operationally ready February 1999, and dedicated in March 1999. Subsequent installations proceeded rapidly and the final installation took place in January 2000. The new system has already been upgraded. The software has been upgraded to allow the FAA to fully exploit the system capability of the new platform that had been installed in HOCSR Phase 1. The Phase 2 software improvements were operational at 22 of the 23 sites in September 2000.[8] The HOCSR team is currently conducting engineering analyses and developing detailed schedules in preparation for HOCSR Phases 3 and 4 activities to replace critical peripherals.

9.1.3 Common Automated Radar Terminal System

The Common Automated Radar Terminal System (ARTS) Program was recently completed with the commissioning of the Huntington, West Virginia site. Common ARTS is now fully operational at all 133 ARTS IIE sites (small-to-medium TRACONs) and at 5 ARTS IIIE sites (at the large TRACONs at Ft. Worth, New York, Chicago, Southern California, and Denver). Common ARTS will remain the primary terminal automation system until it is replaced with the Standard Terminal Replacement System (STARS), which is now under development.

The Common ARTS Program was developed in response to traffic growth throughout the NAS. All ARTS programs have a common air traffic control mission with similar functional requirements. Previous versions had been developed independently, with periodic upgrades of separate systems to add new features. The Common ARTS Program was designed to use identical commercial off-the-shelf (COTS) microprocessors and software to economically upgrade the dated ARTS IIA systems and to enhance the ARTS IIIE systems. The new ARTS systems share a common software baseline that can be adapted to the size and complexity of a facility. This permits the standardization of procedures, training, and logistics support.

The new systems provide modern COTS hardware (with the exception of the displays), more flexible systems architecture, and enhanced site adaptation capability. The new ARTS IIE versions support one or two sensors and up to 22 displays that can process 256 radar tracks per sensor, and have had Mode C Intruder alert capability added. The new ARTS IIIE version supports 15 sensors, over 200 displays, and can process 10,000 simultaneous radar tracks.

9.2 Free Flight Technology Operational Tests

Modernizing the NAS has inherent risks because many of the new technologies have not been operationally tested. To minimize these risks and to gain a better understanding of potential challenges, the FAA has developed two risk mitigation strategies: Free Flight Phase 1 and Safe Flight 21. These programs are intended to reduce technical and financial risks through the implementation of select technologies at specific sites for evaluation by NAS users and the FAA prior to full implementation.

9.2.1 Free Flight Phase 1

The Free Flight Phase 1 Core Capabilities Limited Deployment (FFP1 CCLD) initiative was designed to deliver early benefits of Free Flight to NAS users while mitigating the risks of implementing new technologies. Under this initiative, the FAA is evaluating five technologies: the User Request Evaluation Tool, the Traffic Manager Advisor, the Passive Final Approach Spacing Tool, the Surface Movement Advisor, and Collaborative Decision Making. Each of these technologies is described briefly below.

8 The HOCSR computers have been installed at the 20 en route centers and the three oceanic centers. The Phase 2 software was installed at 22 of the 23 sites by September 2000; the last site, Honolulu, will not go operational on the Phase 2 software until a new facility is commissioned in FY 2001.

User Request Evaluation Tool (URET)
Extracts real time flight plan and tracking data from the HOST computer, builds flight trajectories for all flights within or inbound to the ARTCC and identifies potential separation conflicts, up to 20 minutes in advance. URET will permit greater route flexibility within en route airspace by enabling controllers to more effectively manage user requests. The conflict detection capability will be especially useful in permitting user requests in oceanic airspace.

Traffic Management Advisor (TMA)
Provides en route controllers and traffic management coordinators with automation tools to manage the flow of traffic from a single center into selected major airports, with consideration given to separation, airspace, and airport constraints. Long term improvements include a TMA multi-center capability to enable multiple ARTCCs to meter arrivals into a single terminal, and a descent advisor, which will provide optimized descent point and speed advisories to controllers based on aircraft type.

Passive Final Approach Spacing Tool (pFAST)
Helps controllers select the most efficient arrival runway and arrival sequence within 60 nautical miles of an airport, considering aircraft type, speed, and trajectory. Active FAST (aFAST) will enhance pFAST capabilities by helping controllers determine how to vector aircraft onto final approach.

TMA and pFAST together constitute the Center Terminal Radar Approach Control Automation System (CTAS). CTAS combines the capabilities of these systems to help controllers efficiently descend, sequence, and space arriving aircraft within 200 nautical miles of an airport.

Surface Movement Advisor (SMA)
Promotes sharing of dynamic surface-related information among airlines, airport operators, and air traffic controllers in order to control the efficient flow of aircraft and vehicles on the airport surface. The system provides prediction capabilities to controllers to help them more efficiently manage operational resources and to optimize airport configurations. The Surface Management System (SMS), evolved from the SMA, will provide airport configuration, aircraft arrival/departure status, and airfield ground movement advisories to controllers, dispatchers, and traffic flow managers. The SMA, through more efficient coordination of information and enhanced management of ground support services, allows for faster aircraft turnarounds, reduced communications, fewer unnecessary diversions, and reduced taxi times and takeoff delays.

Collaborative Decision Making (CDM)
Both a philosophy of traffic management and an array of computer tools that facilitate a real-time collaboration between the FAA, and the airlines. CDM provides FAA traffic flow managers and airline dispatchers with the same real-time information. It links the FAA with the dispatch systems of the airlines and provides the airlines with access to NAS data, including weather, equipment, and delays. CDM allows the FAA to manage the air traffic system more efficiently and the airlines to employ their aircraft more effectively.

Figure 9-1

Free Flight Phase 1 Deployment Sites

Figure 9-1 shows the airports, TRACONs and ARTCCs where these technologies have been deployed. In the map, the United States is divided by the boundaries of the airspace managed by each center. The individual facilities where the FFP1 tools have been deployed are identified by symbols.

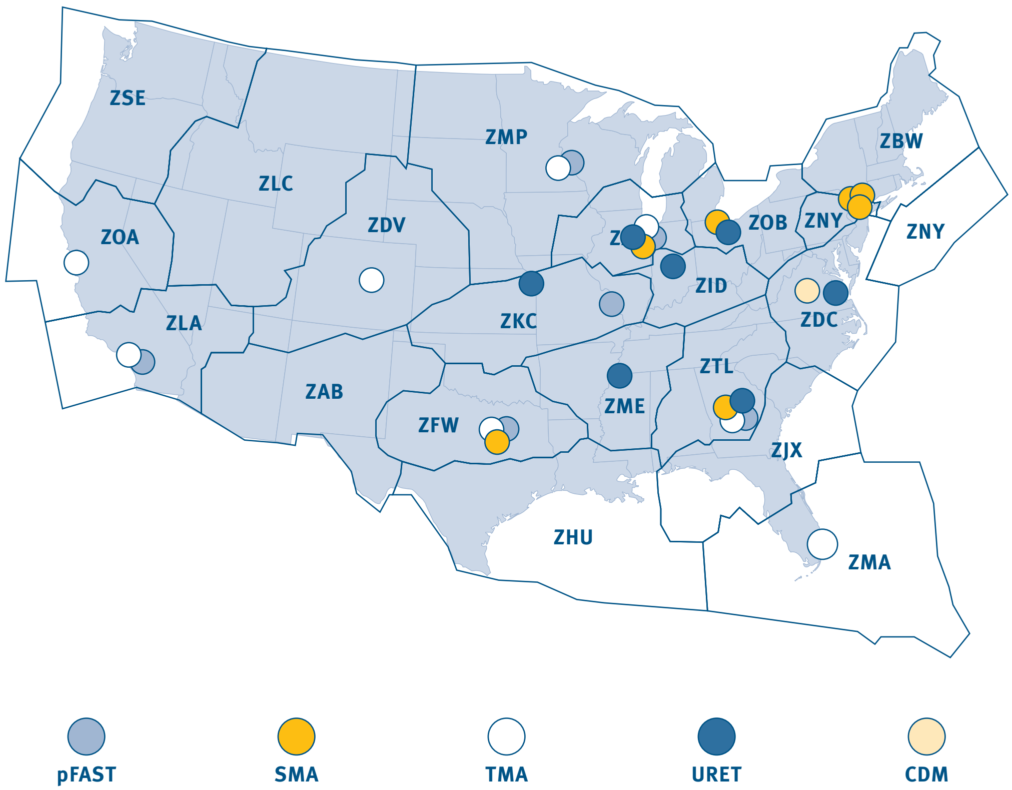

Figure 9-2 identifies the specific sites where each of the separate technologies have been deployed and the remaining sites under the FFP1 program. URET and TMA are deployed at ARTCCs, pFAST is deployed at TRACONs, and SMA is deployed at airports. The central functions of CDM are located at the Command Center, but other functions are located at the Volpe Center in Cambridge, Massachusetts and at traffic management units at the 20 ARTCCs and at selected TRACONs.

Figure 9-2

ATC Facilities with Current and Planned FFP1 Deployments

SMA at Airports	**URET** at ARTCCs	**TMA** at ARTCCs	**pFAST** at TRACONs
Atlanta	**Indianapolis**	**Atlanta**	**Fort Worth**
Detroit	**Memphis**	**Denver**	Atlanta
Indianapolis	Atlanta	**Fort Worth**	Chicago
Philadelphia	Chicago	**Los Angeles**	Los Angeles
Chicago	Cleveland	**Minneapolis**	Minneapolis
Dallas/Fort Worth	Kansas City	**Miami**	St. Louis
Newark	Washington	Chicago	
Teterboro		Oakland	

Deployed capabilities in bold

9.2.1.1 Results of Free Flight Phase 1 Deployment

The FFP1 program has been successfully implemented at all of its initially planned sites and has been extended to others. In addition, the new technologies are bringing real and measurable improvements.

- User Request Evaluation Tool prototypes have been deployed at Indianapolis and Memphis. Controller usage of the prototype continues to increase and to satisfy their requests, the FAA increased its availability from 16 to 22 hours per day in February 2000. URET has increased the number of direct routes at Indianapolis and Memphis by approximately 30 percent.
- Traffic Management Advisor is fully operational at the Ft. Worth TRACON. Early indications show that TMA has increased the arrival rate at Dallas/Fort Worth airport by five percent. Early prototypes are deployed at Denver, Miami, Atlanta, and Los Angeles centers.
- Passive Final Approach Spacing Tool is fully operational at the Ft. Worth TRACON. Initial analysis shows that controllers are able to add one or two arrivals per rush (a rush is a 30-minute period of concentrated traffic), of which Dallas/Fort Worth airport has eight per day. Site system tests of pFAST were completed at the Southern California and Atlanta TRACONs in April 2000. The FAA completed installation of pFAST at the Minneapolis TRACON in May 2000.
- The Surface Movement Advisor deployment has been completed on schedule and within budget. SMA has been in daily use at Philadelphia International and Detroit Metropolitan airports since December 1998. SMA became operational at Dallas/ Fort Worth, Chicago O'Hare, Newark, and Teterboro airports in December 1999. An early version of SMA, which differs from the FFP1 systems, is being used at Atlanta Hartsfield. Northwest Airlines reports that SMA has helped them avoid three-to-five diversions per week at their Detroit hub during inclement weather.
- In Collaborative Decision Making, the FAA has completed Ground Delay Program Enhancement and Initial Collaborative Routing, two of the three basic elements that define CDM for FFP1. CDM to date has helped the FAA and the airlines avoid over 10 million minutes of delay. Special Use Airspace information became available to the CDMNet on June 1, 2000.

9.2.2 Free Flight Phase 2

The FAA recently prepared for the next phase of NAS Modernization by creating an office for Free Flight Phase 2 (FFP2). Free Flight Phase 2 builds on the successes of Free Flight Phase 1 to improve safety and efficiency within the NAS. FFP2 includes the east-to-west expansion of Phase 1 elements to other FAA facilities. FFP2 will also provide incremental enhancements to those elements during the period 2003-2005.

The full deployment of FFP1 capabilities will require support from other programs that provide improvements to the NAS infrastructure. The recent completion of the DSR and HOSCR programs are the first steps towards that goal. FFP2 will also develop several new Free Flight capabilities, which are described briefly below.

Collaborative Routing Coordination Tool
A set of automation capabilities that can evaluate the impact of traffic flow management re-routing strategies.

High Altitude Airspace Concepts
Will provide efficiencies in sectors above 35,000 feet at all FAA Air Route Traffic Control Centers.

Controller Pilot Data Link Communication (CPDLC)
Will allow voice messages to be replaced with data messages that are displayed in the cockpit. The initial version of CPDLC, Build 1, will use a combination of analog and digital data link technologies to provide an incremental step for implementing en route data links. CPDLC Build 1A, Build 2, and Build 3 will expand the message set to include additional key flight data and will eventually provide a fully integrated all-digital system.

9.2.3 Safe Flight 21

Safe Flight 21 is a five-year government and industry effort to demonstrate the capabilities of advanced communication, navigation, surveillance, and air traffic procedures associated with Free Flight. Safe Flight 21 expects to validate the modernization effort and accelerate its progress, while minimizing the long-term risks and costs. The Safe Flight 21 initiative will focus primarily on developing a suitable avionics technology, pilot procedures for air-to-air surveillance of other aircraft, and a compatible ground-based automatic dependent surveillance system for air traffic control facilities. The Safe Flight 21 initiatives will demonstrate the usefulness of two new technologies, which are described below.

Automatic Dependence Surveillance-Broadcast (ADS-B)
A surveillance system that continuously broadcasts GPS position information, aircraft identification, altitude, velocity vector, and direction to all other aircraft and air traffic control facilities within a specific area. ADS-B information will be displayed in the cockpit via a cockpit display of information (CDIT) unit, providing the pilot with greater situational awareness. ADS-B transmissions will also provide controllers with a more complete picture of traffic and will update that information more frequently than will other surveillance equipment. On the surface, ground vehicles can also use ADS-B to be visible to, and to see, taxiing aircraft.

Traffic Information System-Broadcast (TIS-B)
A communications system that will transmit traffic and other information available on the ground to the cockpit. TIS-B will also provide pilots with greater situational awareness.

The Safe Flight 21 program will also quantify operational benefits, demonstrate capabilities, and collect data on the performance of three candidate data link technologies for air-to-air surveillance: Mode Select (Mode S) Extended Squitter, Universal Access Transceiver, and VHF Data Link (VDL) Mode 4.

Safe Flight 21 demonstration projects have been initiated at two sites: in the Ohio Valley in collaboration with the Cargo Airline Association and in western Alaska with commercial aircraft providing passenger, mail, and freight services. A common design is being used for the two project sites to facilitate the collection and analysis of data.

9.2.3.1 Ohio Valley Project

Safe Flight 21's Ohio Valley Project is testing ADS-B avionics on commercial cargo aircraft in the Ohio Valley. These tests are taking place in terminal areas with significant cargo operations, including Memphis, Tennessee; Wilmington, Ohio; Louisville, Kentucky; Scott Air Force Base, Illinois, and Nashville, Tennessee. The Ohio Valley Project is co-sponsored by the Cargo Airline Association (CAA) and the FAA. The CAA has purchased, equipped, and is maintaining the avionics for the test aircraft. The CAA members are conducting revenue flights with these aircraft to evaluate the systems' performance in normal operations.

The FAA has purchased, installed, and is maintaining ground systems at the five sites. A ground broadcast server has been installed at the Wilmington site that receives data from the other sites and depicts ADS-B targets fused with radar targets. As the project proceeds, fused ADS-B and radar target data will be made available to suitably-equipped aircraft to enable the pilots to see both targets on a cockpit display, along with selected broadcast information such as weather maps, special use airspace status, and wind shear alerts.

The Ohio Valley Project is being assessed in a series of Operational Evaluations. The first evaluation demonstration took place in July 1999 at the Wilmington site. It concentrated on measuring the improvement in the test aircraft's ability to make approaches in low visibility conditions and their enhanced ability to see-and-avoid adjacent traffic. Cargo carriers, the FAA, NASA, the military, and academia participated in this initial evaluation. During the demonstration, aircraft equipped with ADS-B enabled pilots to consistently maintain close separation.

The second operational evaluation is scheduled for October 2000 at the Louisville site, with as many as 20 aircraft expected to participate. CAA members have committed eight aircraft and other aircraft from NASA, the U.S. Navy, and the Aircraft Owners and Pilots Association are expected. The third operational evaluation is scheduled for the Memphis site in May 2001.

9.2.3.2 Alaska Capstone Program

The Capstone Program was developed by the FAA in response to an NTSB safety study, Aviation Safety in Alaska, to address Alaska's high accident rate for small aircraft, which is five times the national average. The principal objective of the Capstone Program is to improve pilots' situational awareness of the flight environment and to thereby avoid mid-air collisions and controlled flight into terrain. A recent FAA-sponsored study estimated that 38 percent of commercial operator accidents in Alaska could be avoided if information on position relative to terrain and real-time weather information were available to pilots in the cockpit. The Capstone Program will attempt to validate these safety projections.

The FAA will equip up to 150 commercial aircraft in a non-radar environment in the Yukon-Kuskokwim Delta region of southwest Alaska with the Capstone avionics suite.[9] It includes a cockpit multifunction display, a GPS navigation/communications unit, a Universal Access Transceiver datalink unit, and a GPS-based terrain database of Alaska. The suite enables each participating aircraft to broadcast its identification, position, altitude, climb rate, and direction and to receive similar signals from other aircraft.

The FAA will install a network of 12 data-link ground stations that will transmit radar targets of non-participating aircraft to the Capstone aircraft. In addition, the ground stations

9 The FAA recently issued a supplemental type certificate for a Capstone avionics package. The STC provides the necessary authorization to install the avionics in 23 types of small aircraft that will be used in the Capstone demonstrations.

will transmit flight information services, including weather reports and forecasts, maps, status of special use airspace, pilot reports, and notices to airmen. The FAA is also publishing non-precision approaches and installing automated weather observation systems at ten village airports in the Delta region.

The University of Alaska Anchorage (UAA) is conducting training sessions for Capstone as well as conducting an in-depth safety study and assessment of Capstone. UAA will train a cadre of instructors who will in turn conduct individual company training. The training program began in Bethel, Alaska in early February 2000 and will continue until each participating commercial company has at least one fully-trained instructor and a complete set of Capstone modules with reference library materials. The safety study will assess the benefits of the Capstone avionics and the use of new flight procedures.

The initial improvements of Capstone are directed towards pilots conducting VFR operations. In the future, the FAA plans to certify systems and equipment and develop enhanced operational procedures for IFR operations. When this is accomplished, ADS-B can be used for air traffic control functions just as radar is now used.

9.2.4 Other Modernization Programs

Each phase of NAS Modernization has programs that will affect each operating environment. Figures 9-3 through 9-5 identify the evolutionary programs of NAS Modernization by time and phase of flight, providing an overview of the time line as well as the relationships among programs.

Figure 9-3

NAS Modernization Phase 1 (1998-2002)

Phase of Flight	Key Event	Capability
Operational Planning	Deploy initial CDM to increase the electronic exchange of information between the airlines and the FAA, as part of Free Flight Phase 1.	Increases collaboration between the FAA and airlines allowing for more flexibility in planning operations.
	Begin deployment of OASIS.	Resolves critical hardware supportability issues and improves available information displayed to the flight service specialist.
Airport Surface Operations	Continue commissioning of ASDE-3 with AMASS to increase detection of aircraft and vehicles on runways and taxiways at the 34 busiest airports.	Increases safety by reducing the probability of collisions and increasing the controllers' situational awareness.
	Deploy SMA at selected airports as part of Free Flight Phase 1.	Provides aircraft arrival information to airline ramp operators/managers.
Departures/Arrivals	Achieve initial WAAS terminal navigation and precision approach capability.	Provides satellite-based navigation, more precision approaches, and supports terminal area low-altitude direct routing which increases safety and capacity in a limited area.
	Deploy STARS.	Resolves supportability issues and provides a color display to TRACON and tower controllers.
	Deploy CTAS pFAST at selected TRACONs as part of Free Flight Phase 1.	Provides initial controller tools to improve arrival spacing and runway assignments.

Phase of Flight	Key Event	Capability
Departures/Arrivals *continued*	Deploy ITWS stand-alone to selected airports.	Improves windshear alert and hazardous weather information reporting to controllers.
	Deploy digital radar.	Installs new digital airport surveillance radar (ASR-11) for better aircraft and weather detection.
En Route/Oceanic	Achieve initial WAAS en route navigation capability.	Provides satellite-based capability for en route navigation.
	Implement weather on DSR to enable NEXRAD data to be displayed to en route controllers.	Increases the safety of the NAS (hazardous weather avoidance) and allows certain primary long-range radar to be decommissioned.
	Authorize air-to-air ADS-B self-separation procedures in specific situations, such as oceanic passing maneuvers.	Increases operations efficiency by utilizing cockpit surveillance capability.
	As part of Free Flight Phase 1 effort implement as selected sites: • URET CCLD • CTAS TMA single center	Enhances the efficiency of the en route operations: • Helps controllers determine the feasibility of user requested route and altitude changes • Improves arrival sequence planning
	Provide initial FIS to the cockpit.	Increases availability of weather and aeronautical information to the cockpit for properly equipped aircraft.
	Initial multi-sector oceanic data link in all oceanic facilities.	Enables oceanic controller to exchange data messages with FANS-1/A-equipped aircraft.
	Deploy digital radar.	Installs new digital en route air traffic control beacon interrogator radar (ATCBI-6) for better aircraft detection with selective interrogation capability.

Phase of Flight	Key Event	Capability
Operational Planning	Implement flight plan evaluation to increase collaboration with users.	Increases collaboration between the FAA and airlines allowing for more predictability to NAS operations.
Airport Surface Operations	Deploy runway incursion reduction capability at smaller airports to increase the detection of aircraft and surface vehicles.	Increases safety by reducing the probability of collisions and increasing controllers' situational awareness.
	Deploy SMS providing controllers tools to improve surface traffic movement operations.	Provides sequencing and runway information to the AOCs at larger airports.
Departures/Arrivals	Implement TIS on Mode-S to provide traffic information to pilots via Mode-S data link.	Increases situational awareness for pilots of TIS-equipped aircraft by displaying nearby traffic.

Figure 9-4

NAS Modernization Phase 2 (2003-2007)

Figure 9-4

NAS Modernization Phase 2 (2003-2007) – *continued*

Phase of Flight	Key Event	Capability
Departures/Arrivals *continued*	Provide full WAAS terminal navigation and precision approach capability.	Provides satellite-based navigation, more precision approaches, and supports terminal area low-altitude direct routing without restrictions.
	Deploy LAAS CAT I/II/III capability.	Increases the number of precision approaches within the NAS.
	Complete STARS deployment with planned improvements.	Resolves supportability issues and provides TRACON controllers decision support tools for traffic control and planning.
	Complete pFAST national deployment.	Provides controller tools to improve arrival spacing and runway assignments.
	Provide improved weather on STARS at selected airports.	Improves windshear alert and hazardous weather information reporting to controllers.
En Route/Oceanic	Provide terminal surveillance with ADS-B information on STARS.	Provides more accurate aircraft position by integrating ADS information on controller displays.
	Deploy full WAAS en route navigation capability.	Provides satellite-based capability for en route navigation without restrictions.
	Deploy ADS-B gap-filler (passive listening stations) to provide surveillance for areas that currently are not covered by radar.	Provides surveillance services to ADS-B equipped aircraft rather than procedural separation.
	Deploy en route CPDLC Build 2.	Expands message set to reduce voice congestion in high-density traffic areas.
	Implement ADS-A for oceanic surveillance.	Enables controllers to reduce separation between aircraft and grant user requests for fuel efficient altitudes.
	Deploy NEXCOM radios and begin use of digital voice capability in high-altitude en route sectors.	Relieves frequency congestion problems for voice services and provides for clear communications.
	Deploy conflict probe nationally.	Enables controllers to grant user requests based on information that is available across center boundaries.
	Deploy multi-center metering with descent advisor to assist traffic managers and controllers.	Improves the arrival sequencing across multiple centers to congested airports.
	Provide 50/50 nautical mile separations between aircraft in oceanic airspace.	Allows FANS-1/A and ATN-equipped aircraft to fly optimum routes over the ocean.

Figure 9-5

NAS Modernization Phase 3 (2008-2015)

Phase of Flight	Key Event	Capability
Operational Planning	Implement NAS-wide information sharing and full CDM.	Allows common data exchange for flight planning and traffic flow purposes.
	Provide interactive airborne refile to enable increased collaboration with users.	Provides in flight automated exchange and processing of flight plan change requests between pilots and controllers for route clearances.
Airport Surface Operations	Provide integrated tower area surveillance for tower and surface.	Provides tower and TRACON controllers improved surveillance based on ADS-B
	Deploy enhanced SMS.	Improves planning and coordination of arrival/departure and surface operations.
Departures/Arrivals	Transition selected terminal areas to digital communications via NEXCOM (VDL-3) and CPDLC for voice and data exchange among controllers and pilots.	Relieves spectrum congestion problems and allows pilots and ATC to directly exchange messages in the terminal environments.
	Deploy aFAST with wake vortex at TRACONs.	Provides better sequencing, spacing, and runway assignment of aircraft on final approach to congested aircraft.
En Route/Oceanic	Improve en route surveillance with ADS-B.	Provides more accurate aircraft position by integrating ADS information on controllers displays.
	Transition to a NAS-wide data link via full NEXCOM (VDL-3) and CPDLC at all high-altitude sectors.	Relieves spectrum congestion problems and allows pilots and ATC to directly exchange messages in the en route environment.
	Use conflict resolution with multi-center metering to evaluate requested flight path amendments across center boundaries.	Increases ATC capability to accommodate changes to the flight while in flight.